

Landsat 7 -- Exaggerated Rumors of Its Demise

As Samuel Clemens so deftly commented, "The rumors of my death have been greatly exaggerated." So it goes with Landsat 7. Following failure of the sensor's scan line corrector (SLC) last May, not a day seems to go by without someone saying that the Landsat ETM+ data are "unusable". These dire assessments suggest a total ETM+ system failure. To the contrary, today the Landsat 7 ETM+ system continues to produce high quality data quite valuable to many, if not all, users.

Absent the SLC, the remainder of the ETM+ sensor including the primary scanning mirror continues to perform, radiometrically and geometrically, at the same high-level of accuracy and precision as it did before the anomaly. Without the SLC the sensor still provides coverage of approximately 78% of each scene. At first glance, the raw SLC-off image products might appear to be of limited value because of the data gaps. However, these data discontinuities are analogous to what users have always experienced with cloud contamination or other data problems in satellite imagery. For most satellite-acquired Earth imagery, some portion of the surface observations are lost, either obscured by clouds and shadows or absent because of technical problems. For many other earth observing systems, such as AVHRR, MODIS and the new high-resolution systems, merging data from 2 or more observations is commonly used to overcome this problem. Such an approach has not frequently been used with Landsat data in the past.

Based on a late October 2003 meeting and several follow-up teleconferences with selected members of the former Landsat Science Team and selected US agency representatives, the USGS/NASA Landsat team is developing means to compensate for the SLC malfunction, with image processing methods and acquisition strategies to exploit the remaining capability of the Landsat 7 system. The team is refining gap-filling techniques that merge data from multiple acquisitions. They are also developing modifications to the Landsat-7 acquisition scheme to acquire two or more clear scenes as near in time as possible to facilitate this gap-filling process. These merged images potentially resolve most, if not all, of the missing data problems. For most locations these merged image products appear as good as previous single acquisition scenes. This "merged image" approach also offers the potential for overcoming cloud contamination problems, particularly in areas of frequent cloud cover, although as of yet the decision to include "cloud clearing" as a part of the gap-filled product has not been made.

The Landsat-7 experimental products being produced by the USGS and NASA team are encouraging (http://landsat7.usgs.gov/slc_enhancements/). The first of these products will be put into production and available from the USGS EROS Data Center by June 1. In this first release, the product will consist of merges of anniversary dates before and after the SLC failure. A more advanced product that merges data from multiple SLC-off scenes acquired within weeks of each other will be released as soon as possible.

One system factor that most seriously suffers from the Landsat 7 SLC loss is the apparent reduction in temporal repeat frequency of coverage, as it now takes two or more acquisitions to produce one complete view. For many users this loss of temporal repeat coverage may not be noticeable because their needs are met by one clear view per season. However, for users such as

agricultural analysts, this loss of temporal coverage is a serious problem, that can only be addressed in the short run with Landsat 5, as long as it lasts, and will only be properly addressed by the near-term deployment of a follow-on Landsat-type mission. We fully understand that this Landsat 7 “merge data” recovery process does not mitigate the immediate need to move ahead on Landsat data continuity, nor eliminate the need for continued Landsat 5 coverage. Nevertheless, continued exploitation of the high quality observation capacity of Landsat 7 is clearly achievable and should be an active goal for all concerned users.

In summary, the rumors of Landsat 7’s demise are indeed exaggerated. The Landsat 7 ETM+ system continues to produce high quality data of the Earth’s land areas. In mid-July 2003 the ETM+ resumed its global land survey mission resulting in only a 6-week gap in contributing imagery to the U.S. archive. To fulfill the expectations of the user community for full coverage single scenes, data from multiple acquisitions will be merged to fill the SLC-off data gaps.

With this said, the only truly effective long-term solution for all users is the implementation of a robust Landsat-type Earth observation program which would include the launch of a new Landsat-type observatory as soon as possible.

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